## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| In re Patent Application of: **AMMAR** | |
| Serial No. **09/863,030** | Examiner: J. Mondt |
| Filing Date: **May 22, 2001** | |
| Confirmation No. **7280** | Art Unit: 2826 |
| For: **THICK FILM MILLIMETER WAVE TRANSCEIVER MODULE** | |

## DECLARATION OF DAN F. AMMAR UNDER 37 CFR SECTION 1.132



Mail Stop AF
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, **Dan F. Ammar**, declare as follows:

1. I am the inventor of the subject matter described in the above-identified patent application. I am also co-founder and Vice President of Engineering for Xytrans, Inc. of Orlando, Florida (hereinafter "Xytans"), the assignee of the above-identified application. I co-founded Xytrans three years ago with other executives from Lockheed Martin Corporation.

2. I have a masters degree in electrical engineering from George Washington University.

3. Before co-founding Xytrans, I worked at Lockheed Martin Corporation for 11 years as an enginner, a technical

director and a program manager. During my tenure at Lockheed Martin I developed the first millimeter wave (MMW) RF radio and four generations of MMW transceivers for a commercial network supplier using microwave monolithic integrated circuit (MMIC) chip technology. Prior to my employment at Lockheed Martin Corporation, I was the manager of engineering and technology for Allied Signal Corporation in Boca Raton, Florida for 5 years where I was responsible for the development and production of a commercial avionics products line. I have also designed and developed RF sensors at Martin Marietta and Westinghouse Electric.

4. Xytrans is engaged in the research and development of high-frequency, millimeter wave (MMW) transceivers and outdoor units for high-capacity broadband wireless communications in frequency bands between about 10 and 100 GHz. Xytrans' products use microwave monolithic integrated circuit (MMIC) chips and are manufactured in innovative small packages that are up to ten times smaller and less costly than competing products commercially available on the market today.

5. I have reviewed the above-identified patent application, the cited prior art, the first Office Action, the Amendment and response to the first Office Action, and the Final Office Action dated April 4, 2003.

6. One of the initial drawbacks that we confronted at Xytrans in developing MMW RF modules was the necessity of using a high number of MMIC chips, substrates and peripherals installed in each radio frequency module. A typical millimeter wave

transceiver would have about 10 to about 15 MMIC chips, 15-20 pieces of substrate, and 50-60 other peripheral components, including resistors and capacitors. For example, most MMIC chips have on-board capacitors and resistors. These were insufficient for bypassing and biasing the MMIC chip. As a result, capacitors were placed about one or two mils from the MMIC, and these and other closely spaced peripherally located active and passive components were connected using wire or ribbon bonds. This was a challenge to millimeter wave module manufacturing companies in producing low-cost and small size transceivers because of the large number of peripheral or other connections to a MMIC chip.

7. Low temperature co-fired ceramic materials, such as thick film green tape layers, although inexpensive, had typically only been used below 10 GHz range for transceiver modules and not used at millimeter wavelengths because of the close manufacturing tolerances that were difficult to obtain. At Xytrans, we researched and developed a new use for this material in MMW RF modules using MMIC chips. Prior art use of green tape typically included a layer with radio frequency transmission lines and cut-outs to receive the MMIC chips. An example of such a millimeter wave ceramic package is taught in the cited U.S. Patent No. 5,451,818 to Chan et al. (hereinafter "Chan"). This MMIC package is a hermetic enclosure and enables RF input and output (I/O) and DC bias signals to be communicated through the package walls formed by the ceramic. A base plate and cover are included. This type of MMIC package is connected to other passive and active components (including capacitors) and other

MMIC chips by ribbon bonds or similar connections. It is operable at about 30 GHz.

8. At Xytrans, we were familiar with this type of MMIC package, such as Chan, which shows a base 12 (possibly ceramic) and ceramic substrate 14 on top, which can include printed, fired etchable conductive layers. A dielectric tape 20 was fused at the top surface 14b of the ceramic substrate. RF transmission lines 18 were etched into the opposite surface and used to communicate from the MMIC chip and outside this package. Chan's substrate 14 formed a cavity in which two (or more) MMIC chips 30a, 30b were packaged. A lid was formed over a seal ring applied to a conductive layer on the top surface of the tape, i.e., green tape.

9. Chan clearly shows a simple package having a cavity where one or more MMIC chips can be connected to peripheral components outside the package by the RF transmission lines as peripherals extending through the package.

10. Xytrans has developed a totally new and innovative millimeter wave transceiver design. A large number of MMIC chips used for receiver, transmitter and local oscillator circuits are bonded to a multilayer, ceramic substrate board. In addition, a number of other surface mount circuits are assembled on ceramic board using traditional surface mount methods. The unique and unobvious Xytrans substrate board is small in size, about 3x3 inches and is shown in Exhibit 1. The board is shown mounted on a base plate in Exhibit 2, with the RF cover lying adjacent.

MMIC chips, SMA connectors and other components are directly connected to the top surface of the substrate board.

11. The Xytrans MMW RF transceiver goes far beyond Chan and similar prior art MMIC packages by having a number of low temperature co-fired ceramic sheets, i.e., green tape layers, pressed together on top of each other (as many as 12 or more as noted in the specification). Each sheet is a preferred planar green tape layer and is "burned," and the resultant product forms a planar substrate board having a planar top surface on which MMIC chips are surface mounted. Passive components, such as resistors and the capacitors, which normally are positioned adjacent a MMIC and attached by a ribbon or other connection, are now embedded in one planar sheet layer. Filters can also be embedded. Another planar sheet is a ground layer. Yet another planar sheet includes embedded DC signal lines for a DC signals layer. Interconnects extend between the planar sheets. The planar sheets are compressed and heated and described in the patent application. The resultant planar configured substrate board in FIG. 1 shows the overall sheet having a planar top surface (no cavity as in Chan). This is also shown in FIGS. 3 and 4 of the instant application.

12. Any low frequency signal connections, DC connections, ground connections, and passive devices are embedded in the different sheets forming the different layers of the substrate board. A planar configured solder pre-form layer can be positioned over the top surface of the substrate board for securing MMIC dies. Silver epoxy can also be used instead of the

solder pre-form to attach MMIC dies on top of the planar surface formed by the substrate board. A top layer over the planar surface can have cut-outs configured for receiving the MMIC chips in a position for the transceiver design, i.e., in a receiver, transmitter, and local oscillator section.

13. The Xytrans transceiver design eliminates the many prior art interconnects to peripherals, such as capacitors by using embedded capacitors and resistors and accomplishes interconnection between embedded components and the different layers using the embedded interconnections within the substrate board. This allows interconnection of embedded capacitors, resistors, filters and other components. Because electrical connections and passive components are embedded in the multilayer board, the number of wire or ribbon bonds are reduced. Chan, on the other hand, is a simple MMIC package. A cavity is formed on a ceramic substrate, which includes the DC input and RF lines with many peripheral interconnects. Indeed, Chan would have peripheral capacitors connected by the lateral RF transmission lines.

14. In the present invention, RF isolation for any receiver, transmitter and local oscillator sections are provided by a channelization plate having preferably electrically discharge machined channels and received over the substrate board. A cover is received over the channelization plate, as with the sample shown in Exhibit 2.

15. The present invention also permits unique inputs and outputs. Any coaxial connectors are attached directly to the

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substrate and radio frequency waveguide transitions can be printed directly on the substrate. SMA and K-connectors are attached directly to the substrate. Vias can extend through the substrate in one or more sheets and provide additional isolation.

16. I have also reviewed the other cited references. Wong only shows the use of a solder connection for a flip chip MMIC as compared to straight chips and wire of the present invention. Moe discloses a base plate with a certain thickness for a MMIC hybrid device. Shiau uses thin film technology. Baudet, Osika and Douriet are less relevant.

17. I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title XVIII of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

6/27/03
Date

**DAN F. AMMAR**

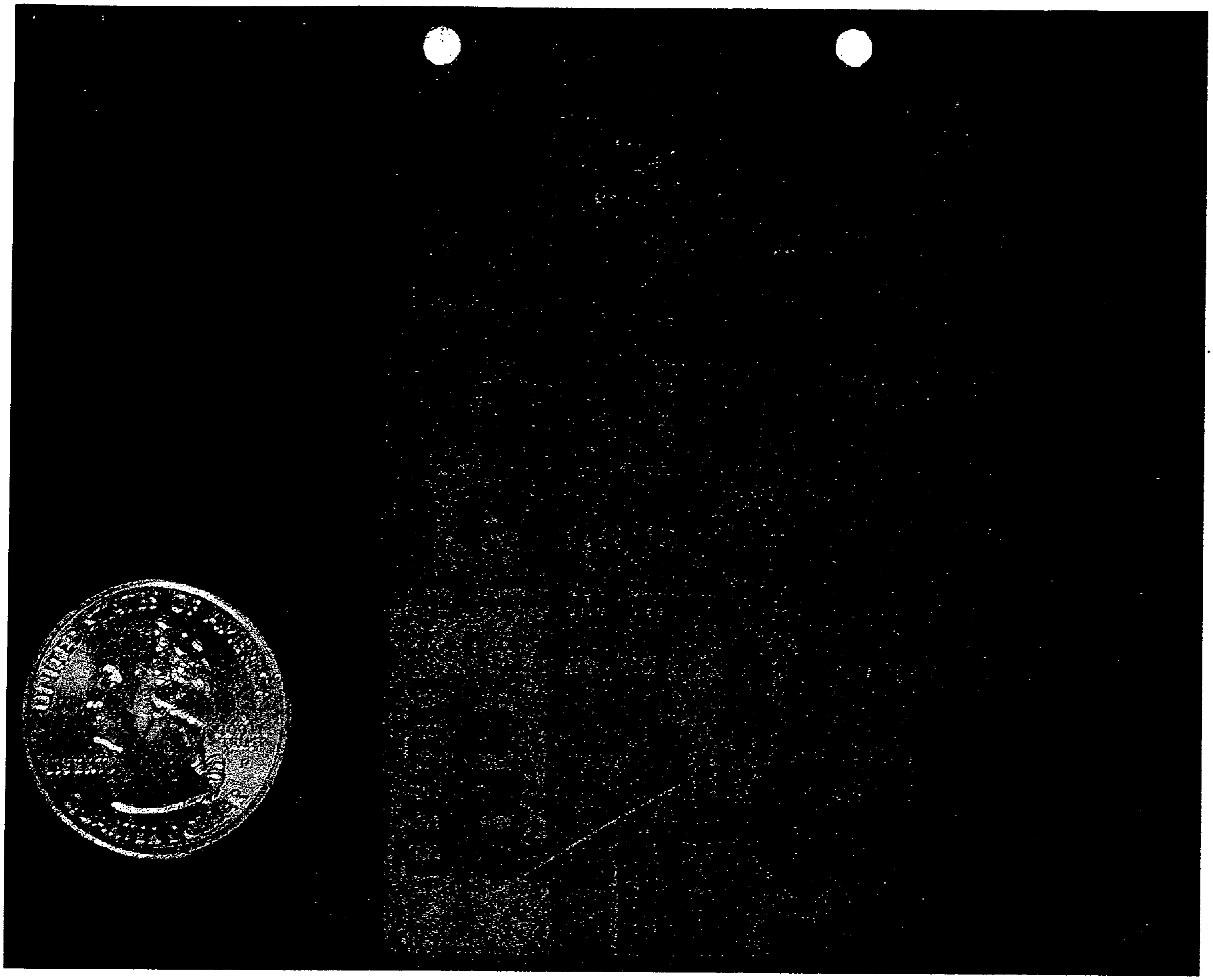

**EXHIBIT 1**

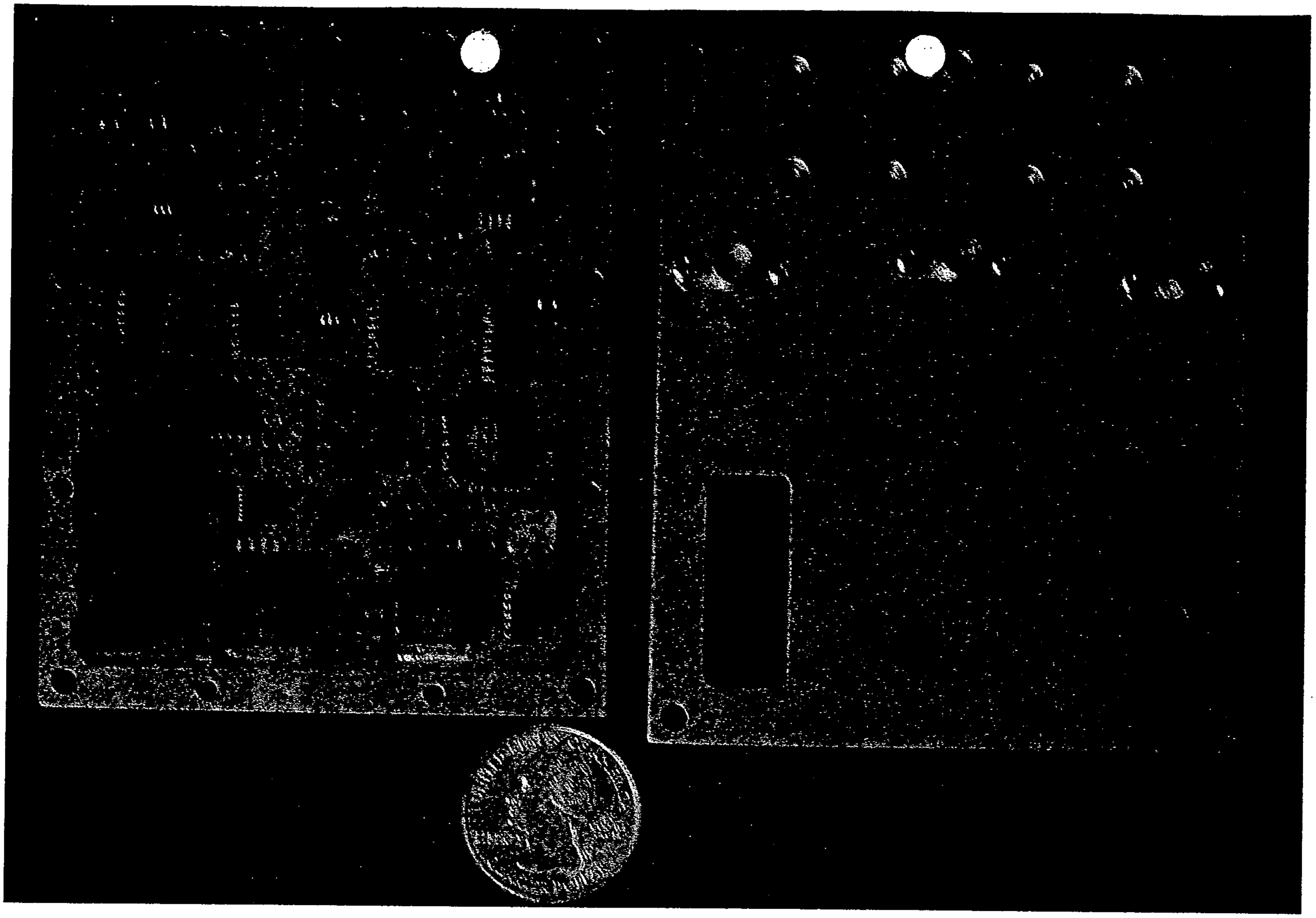

EXHIBIT 2

# Multi-layer Ceramic Board

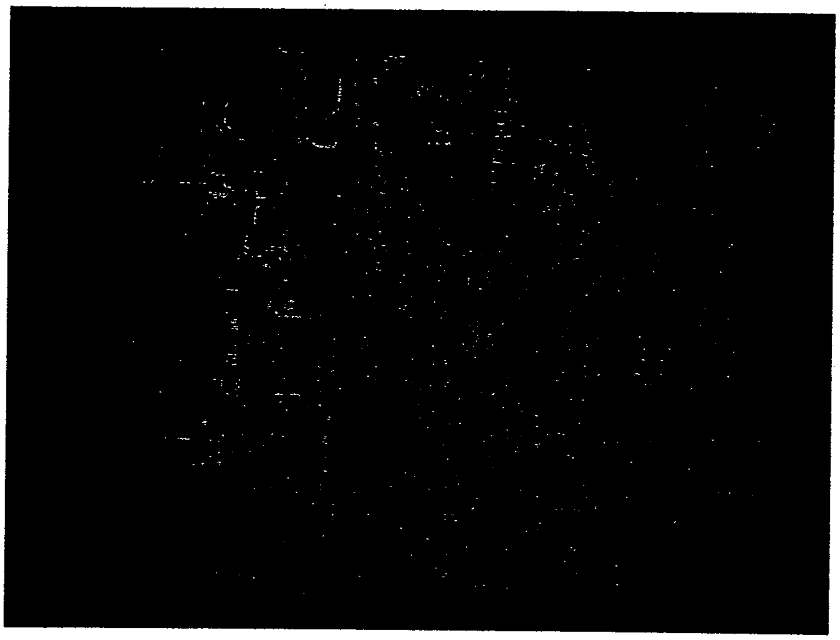

**EXHIBIT 3**

# Multi-layer Ceramic Transceiver module

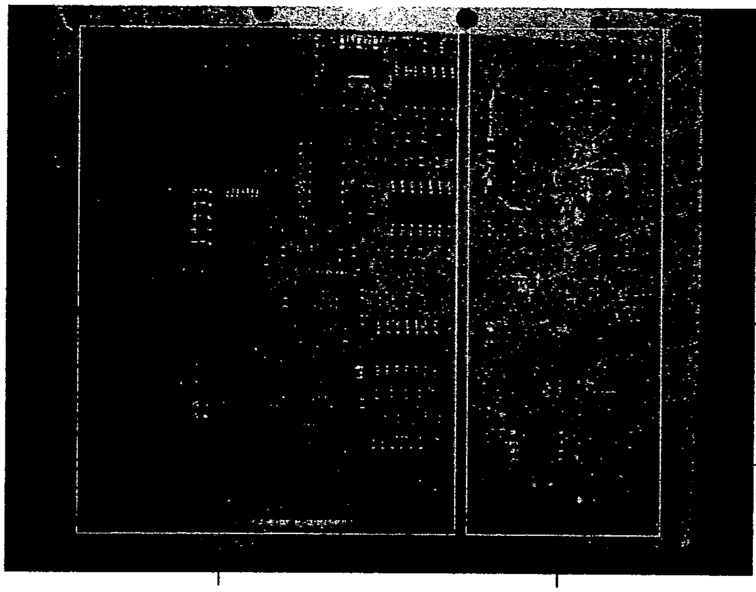


**EXHIBIT 4**